107TH CONGRESS
2D SESSION

S. 2945

To authorize appropriations for nanoscience, nanoengineering, and nanotechnology research, and for other purposes.

IN THE SENATE OF THE UNITED STATES

SEPTEMBER 17, 2002

Mr. WYDEN (for himself, Mr. LIEBERMAN, Mr. ALLEN, Ms. LANDRIEU, and Mrs. CLINTON) introduced the following bill; which was read twice and referred to the Committee on Commerce, Science, and Transportation

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A BILL

To authorize appropriations for nanoscience, nanoengineering, and nanotechnology research, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the ''21st Century Nanotechnology Research and Development Act''.

SEC. 2. FINDINGS.

The Congress makes the following findings:

(1) The emerging fields of nanoscience and nanoengineering (collectively, ''nanotechnology''), in

which matter is manipulated at the atomic level (i.e., atom-by-atom or molecule-by-molecule) in order to build materials, machines, and devices with novel properties or functions, are leading to unprecedented scientific and technological opportunities that will benefit society by changing the way many things are designed and made.

(2) Long-term nanoscale research and development leading to potential breakthroughs in areas such as materials and manufacturing, electronics, medicine and healthcare, environment, energy, chemicals, biotechnology, agriculture, information technology, and national security could be as significant as the combined influences of microelectronics, biotechnology, and information technology on the 20th century. Nanotechnology could lead to things such as—

(A) new generations of electronics where the entire collection of the Library of Congress is stored on devices the size of a sugar cube;

(B) manufacturing that requires less material, pollutes less, and is embedded with sophisticated sensors that will internally detect signs of weakness and automatically respond by releasing chemicals that will prevent damage;

(C) prosthetic and medical implants whose surfaces are molecularly designed to interact with the cells of the body;

(D) materials with an unprecedented combination of strength, toughness, and lightness that will enable land, sea, air, and space vehicles to become lighter and more fuel efficient;

(E) selective membranes that can fish out specific toxic or valuable particles from industrial waste or that can inexpensively desalinate sea water; and

(F) tiny robotic spacecraft that will cost less, consume very little power, adapt to unexpected environments, change its capabilities as needed, and be completely autonomous.

(3) Long-term, high-risk research is necessary to create breakthroughs in technology. Such research requires government funding since the benefits are too distant or uncertain for industry alone to support. Current Federal investments in nanotechnology research and development are not grounded in any specifically authorized statutory foundation. As a result, there is a risk that future funding for long-term, innovative research will be tentative and subject to instability which could threaten to hinder fu-

ture Untied States technological and economic growth.

(4) The Federal government can play an important role in the development of nanotechnology, as this science is still in its infancy, and it will take many years of sustained investment for this field to achieve maturity.

(5) Many foreign countries, companies and scientists believe that nanotechnology will be the leading technology of the 21st century and are investing heavily into its research. According to a study of international nanotechnology research efforts sponsored by the National Science and Technology Council, the United States is at risk of falling behind its international competitors, including Japan, South Korea, and Europe if it fails to sustain broad based funding in nanotechnology. The United States cannot afford to fall behind our competitors if we want to maintain our economic strength.

(6) Advances in nanotechnology stemming from Federal investments in fundamental research and subsequent private sector development likely will create technologies that support the work and improve the efficiency of the Federal government, and con-

tribute significantly to the efforts of the government's mission agencies.

(7) According to various estimates, including those of the National Science Foundation, the market for nanotech products and services in the United States alone could reach over $1 trillion later this century.

(8) Nanotechnology will evolve from modern advances in chemical, physical, biological, engineering, medical, and materials research, and will contribute to cross-disciplinary training of the 21st century science and technology workforce.

(9) Mastering nanotechnology will require a unique skill set for scientists and engineers that combine chemistry, physics, material science, and information science. Funding in these critical areas has been flat for many years and as a result fewer young people are electing to go into these areas in graduate schools throughout the United States. This will have to reverse if we hope to develop the next generation of skilled workers with multi-disciplinary perspectives necessary for the development of nanotechnology.

(10) Research on nanotechnology creates unprecedented capabilities to alter ourselves and our

environment and will give rise to a host of novel social, ethical, philosophical, and legal issues. To appropriately address these issues will require wide reflection and guidance that are responsive to the realities of the science, as well as additional research to predict, understand, and alleviate anticipated problems.

(11) Nanotechnology will provide structures to enable the revolutionary concept of quantum computing, which uses quantum mechanical properties to do calculation. Quantum computing permits a small number of atoms to potentially store and process enormous amounts of information. Just 300 interacting atoms in a quantum computer could store as much information as a classical electronic computer that uses all the particles in the universe, and today's complex encryption algorithms, which would take today's best super computer 20 billion years, could be cracked in 30 minutes.

(12) The Executive Branch has previously established a National Nanotechnology Initiative to coordinate Federal nanotechnology research and development programs. This initiative has contributed significantly to the development of nanotechnology. Authorizing legislation can serve to establish new

technology goals and research directions, improve agency coordination and oversight mechanisms, help ensure optimal returns to investment, and simplify reporting, budgeting, and planning processes for the Executive Branch and the Congress.

(13) The private sector technology innovations that grow from fundamental nanotechnology research are dependent on a haphazard, expensive, and generally inefficient technology transition path. Strategies for accelerating the transition of fundamental knowledge and innovations in commercial products or to support mission agencies should be explored, developed, and when appropriate, executed.

(14) Existing data on the societal, ethical, educational, legal, and workforce implications and issues related to nanotechnology are lacking. To help decision-makers and affected parties better anticipate issues likely to arise with the onset and maturation of nanotechnology, research and studies on these issues must be conducted and disseminated.

SEC. 3. PURPOSE.

It is the purpose of this Act to authorize a coordinated inter-agency program that will support long-term nanoscale research and development leading to potential breakthroughs in areas such as materials and manufac-

turing, nanoelectronics, medicine and healthcare, environment, energy, chemicals, biotechnology, agriculture, information technology, and national and homeland security.

SEC. 4. NATIONAL NANOTECHNOLOGY RESEARCH PROGRAM.

(a) NATIONAL NANOTECHNOLOGY RESEARCH PROGRAM.—The President shall establish a National Nanotechnology Research Program. Through appropriate agencies, councils, and the National Coordination Office, the program shall—

(1) establish the goals, priorities, grand challenges, and metrics for evaluation for Federal nanotechnology research, development, and other activities;

(2) invest in Federal research and development programs in nanotechnology and related sciences to achieve those goals; and

(3) provide for interagency coordination of Federal nanotechnology research, development, and other activities undertaken pursuant to the program.

(b) GOALS OF THE NATIONAL NANOTECHNOLOGY RESEARCH PROGRAM.—The goals of the program are as follows:

(1) The coordination of long-term fundamental nanoscience and engineering research to build a fun-

damental understanding of matter enabling control and manipulation at the nanoscale.

(2) The assurance of continued United States global leadership in nanotechnology to meet national goals and to support national economic, health, national security, educational, and scientific interests.

(3) The advancement of United States productivity and industrial competitiveness through stable, consistent, and coordinated investments in long-term scientific and engineering research in nanotechnology.

(4) The development of a network of shared academic facilities and technology centers that will play a critical role in accomplishing the other goals of the program, foster partnerships, and develop and utilize next generation scientific tools.

(5) The development of enabling infrastructural technologies that United States industry can use to commercialize new discoveries and innovations in nanoscience.

(6) The acceleration of the deployment and transition of advanced and experimental nanotechnology and concepts into the private sector.

(7) The establishment of a program designed to provide effective education and training for the next

generation of researchers and professionals skilled in the multi disciplinary perspectives necessary for nanotechnology.

(8) To ensure that philosophical, ethical, and other societial concerns will be considered alongside the development of nanotechnology.

(c) RESEARCH AND DEVELOPMENT AREAS.—Through its participating agencies, the Nanotechnology Research and Development Program shall develop, fund, and manage Federal research programs in the following areas:

(1) LONG-TERM FUNDAMENTAL RESEARCH.—The program shall undertake long-term basic nanoscience and engineering research that focuses on fundamental understanding and synthesis of nanometer-size building blocks with potential for breakthroughs in areas such as materials and manufacturing, nanoelectronics, medicine and healthcare, environment, energy, chemical and pharmaceuticals industries, biotechnology and agriculture, computation and information technology, and national security. Funds made available from the appropriate agencies under this paragraph shall be used—

(A) to provide awards of less than $1,000,000 each to single investigators and

small groups to provide sustained support to individual investigators and small groups conducting fundamental, innovative research; and

(B) to fund fundamental research and the development of university-industry-laboratory and interagency partnerships.

(2) GRAND CHALLENGES.—The program shall support grand challenges that are essential for the advancement of the field and interdisciplinary research and education teams, including multidisciplinary nanotechnology research centers, that work on major long-term objectives. This funding area will fund, through participatig agencies, interdisciplinary research and education teams that aim to achieve major, long-term objectives, such as the following:

(A) Nanomaterials by design which are stronger, lighter, harder, self-repairing, and safer.

(B) Nanoelectronics, optoelectronics, and magnetics.

(C) Healthcare applications.

(D) Nanoscale processes and environment.

(E) Energy and energy conservation.

(F) Microspacecraft.

(G) Bio-nanodevices for detection and mitigation of biothreats to humans.

(H) Economical, efficient, and safe transportation.

(I) National security.

(J) Other appropriate challenges.

(3) INTERDISCIPLINARY NANOTECHNOLOGY RESEARCH CENTERS.—The appropriate agencies shall fund 10 new centers in the range of $3,000,000 to $5,000,000 per year each for 5 years. A grant under this paragraph to a center may be renewed for 1 5-year term on the basis of that center's performance, determined after a review. The program, through its participating agencies, shall encourage research networking among centers and researchers and require access to facilities to both academia and industry. The centers shall assist in reaching other initiative priorities, including fundamental research, grand challenges, education, development and utilization of specific research tools, and promoting partnerships with industry. To the greatest extent possible, agencies participating in the program shall establish geographically diverse centers including at least one center in a State participating in the National Science Foundation's (NSF) Experimental Program,

to Stimulate Competitive Research (EPSCoR), established under section 113 of the NSF Authorization Act of 1988 (42 U.S.C. 1862(g)).

(4) RESEARCH INFRASTRUCTURE.—The program, through its participating agencies, shall ensure adequate research infrastructure and equipment for rapid progress on program goals, including the employment of underutilized manufacturing facilities in areas of high unemployment as production engineering and research testbeds for micron-scale technologies. Major research equipment and instrumentation shall be an eligible funding purpose under the program.

(5) SOCIETAL, ETHICAL, EDUCATIONAL, LEGAL, AND WORKFORCE ISSUES RELATED TO NANOTECHNOLOGY.—The Director of the National Science Foundation shall establish a new Center for Ethical, Societal, Educational, Legal, and Workforce Issues Related to Nanotechnology at $5,000,000 per year to encourage, conduct, coordinate, commission, collect, and disseminate research on the societal, ethical, educational, legal, and workforce issues related to nanotechnology. The Center shall also conduct studies and provide input and assistance to the Director of the National Science Foundation in com-

pleting the annual report required under paragraph 7(b)(3) of this Act.

(6) TRANSITION OF TECHNOLOGY.—The program, through its participating agencies, shall ensure cooperation and collaboration with United States industry in all relevant research efforts and develop mechanisms to assure prompt technology transition.

SEC. 5. PROGRAM COORDINATION AND MANAGEMENT.

(a) IN GENERAL.—The National Science and Technology Council shall oversee the planning, management, and coordination of the Federal nanotechnology research and development program. The Council, itself or through an appropriate subgroup it designates or establishes, shall—

(1) establish a set of broad applications of nanotechnology research and development, or grand challenges, to be met by the results and activities of the program, based on national needs;

(2) submit to the Congress through the Senate Committee on Commerce, Science, and Transportation, and the House of Representatives Committee on Science, an annual report, along with the President's annual budget request, describing the implementation of the program under section 4;

(3) provide for interagency coordination of the program, including with the Department of Defense;

(4) coordinate the budget requests of each of the agencies involved in the program with the Office of Management and Budget to ensure that a balanced research portfolio is maintained in order to ensure the appropriate level of research effort;

(5) provide guidance each year to the participating departments and agencies concerning the preparation of appropriations requests for activities related to the program;

(6) consult with academic, industry, State and local government, and other appropriate groups conducting research on and using nanotechnology;

(7) establish an Information Services and Applications Council to promote access to and early application of the technologies, innovations, and expertise derived from nanotechnology research and development program activities to agency missions and systems across the Federal government, and to United States industry;

(8) in cooperation with the Advisory Panel established under subsection (b), develop and apply measurements using appropriate metrics for evalu-

ating program performance and progress toward goals; and

(9) identify research areas which are not being adequately addressed by the agencies' current research programs.

(b) PRESIDENT'S NANOTECHNOLOGY ADVISORY PANEL.—

(1) ESTABLISHMENT.—The President shall establish a National Nanotechnology Advisory Panel.

(2) SELECTION PROCEDURES.—The President shall establish procedures for the selection of individuals not employed by the Federal government who are qualified in the science of nanotechnology and other appropriate fields and may, pursuant to such procedures, select up to 20 individuals, one of whom shall be designated Chairman, to serve on the Advisory Panel. Selection of individuals for the Advisory Panel shall be based solely on established records of distinguished fundamental and applied scientific service, and the panel shall contain a reasonable cross-section of views and expertise, including those regarding the societal, ethical, educational, legal, and workforce issues related to nanotechnology. In selecting individuals to serve on the Advisory Panel, the President shall seek and give due consideration

to recommendations from the Congress, industry, the scientific community (including the National Academy of Sciences), scientific professional societies, academia, the defense community, the education community, State and local governments, and other appropriate organizations.

(3) MEETINGS.—The Advisory Panel shall meet no less than twice annually, at such times and places as may be designated by the Chairman in consultation with the National Nanotechnology Coordination Office established under subsection 5(c) of this Act.

(4) DUTIES.—The Advisory Panel shall advise the President and the National Science and Technology Council, and inform the Congress, on matters relating to the National Nanotechnology Program, including goals, roles, and objectives within the program, its capabilities and research needs, guidance on achieving major objectives, and establishing and measuring performance goals using appropriate metrics. The Advisory Panel shall issue an annual report, containing the information required by subsection (d) of this section, to the President, the Council, the heads of each agency involved in the program, the Senate Committee on Commerce, Science, and Transportation, and the House of Rep-

resentatives Committee on Science, on or before September 30 of each year.

(c) NATIONAL NANOTECHNOLOGY COORDINATION OFFICE.—The President shall establish a National Nanotechnology Coordination Office, with full-time staff, to provide day-to-day technical and administrative support to the Council and the Advisory Panel, and to be the point of contact on Federal nanotechnology activities for government organizations, academia, industry, professional societies, and others to exchange technical and programmatic information. The Office shall assure full coordination of research efforts between agencies, scientific disciplines, and United States industry.

(d) PROGRAM PLANS AND REPORTS.—

(1) ANNUAL EVALUATION OF NANOTECHNOLOGY RESEARCH DEVELOPMENT PROGRAM.—The report by the Advisory Panel, required pursuant to subsection (b)(4), shall include—

(A) a review of the program's technical success in achieving the stated goals and grand challenges according to the metrics established by the program and Advisory Panel;

(B) a review of the program's management and coordination;

(C) a review of the funding levels by each agency for the program's activities and their ability to achieve the program's stated goals and grand challenges;

(D) a review of the balance in the program's portfolio and components across agencies and disciplines;

(E) an assessment of the degree of participation in the program by minority serving institutions and institutions located in States participating in NSF's EPSCoR program.

(F) a review of policy issues resulting from advancements in nanotechnology and its effects on the scientific enterprise, commerce, workforce, competitiveness, national security, medicine, and government operations;

(G) recommendations for new program goals and grand challenges;

(H) recommendations for new research areas, partnerships, coordination and management mechanisms, or programs to be established to achieve the program's stated goals and grand challenges;

(I) recommendations for new investments by each participating agency in each program

funding area for the 5-year period following the delivery of the report;

(J) reviews and recommendations regarding other issues deemed pertinent or specified by the panel; and

(K) a technology transition study which includes an evaluation of the Federal nanotechnology research and development program's success in transitioning its research, technologies, and concepts into commercial and military products, including—

(i) examples of successful transition of research, technologies, and concepts from the Federal nanotechnology research and development program into commercial and military products;

(ii) best practices of universities, government, and industry in promoting efficient and rapid technology transition in the nanotechnology sector;

(iii) barriers to efficient technology transition in the nanotechnology sector, including, but not limited to, standards, pace of technological change, qualification and

testing of research products, intellectual property issues, and Federal funding; and

(iv) recommendations for government sponsored activities to promote rapid technology transition in the nanotechnology sector.

(2) OFFICE OF MANAGEMENT AND BUDGET REPORT.—

(A) BUDGET REQUEST REPORT.—Each Federal agency and department participating in the program shall, as part of its annual request for appropriations, submit a report to the Office of Management and Budget which—

(i) identifies each element of its nanotechnology research and development activities that contributes directly to the program or benefits from the program;

(ii) states the portion of its request for appropriations that is allocated to each such element; and

(iii) states the portion of its request for appropriations that is allocated to each program funding area.

(B) OMB REVIEW AND ALLOCATION STATEMENT.—The Office of Management and

Budget shall review each report in light of the goals, priorities, grand challenges, and agency and departmental responsibilities set forth in the annual report of the Council under paragraph (3), and shall include in the President's annual budget estimate, a statement delineating the amount and portion of each appropriate agency's or department's annual budget estimate relating to its activities undertaken pursuant to the program.

(3) ANNUAL NSTC REPORT TO CONGRESS ON THE NANOTECHNOLOGY RESEARCH DEVELOPMENT PROGRAM.—The National Science and Technology Council shall submit an annual report to the Congress that—

(A) includes a detailed description of the goals, grand challenges, and program funding areas established by the President for the program;

(B) sets forth the relevant programs and activities, for the fiscal year with respect to which the budget submission applies, of each Federal agency and department, participating in the program, as well as such other agencies

and departments as the President or the Director considers appropriate;

(C) describes the levels of Federal funding for the fiscal year during which such report is submitted, and the levels proposed for the fiscal year with respect to which the budget submission applies, for each of the program funding areas of the program;

(D) describes the levels of Federal funding for each agency and department participating in the program and each program funding area for the fiscal year during which such report is submitted, and the levels proposed for the fiscal year with respect to which the budget submission applies, and compare these levels to the most recent recommendations of the Advisory Panel and the external review of the program;

(E) describes coordination and partnership activities with State, local, international, and private sector efforts in nanotechnology research and development, and how they support the goals of the program;

(F) describes mechanisms and efforts used by the program to assist in the transition of innovative concepts and technologies from Feder-

ally funded programs into the commercial sector, and successes in these transition activities;

(G) describes coordination between the military and civilian portions, as well as the life science and non-life science portions, of the program in technology development, supporting the goals of the program, and supporting the mission needs of the departments and agencies involved;

(H) analyzes the progress made toward achieving the goals, priorities, and grand challenges designated for the program according the metrics established by the program and the Advisory Panel; and

(I) recommends new mechanisms of coordination, program funding areas, partnerships, or activities necessary to achieve the goals, priorities and, grand challenges established for the program.

(4) TRIENNIAL EXTERNAL REVIEW OF NANOTECHNOLOGY RESEARCH AND DEVELOPMENT PROGRAM.—

(A) IN GENERAL.—Not later than 6 months after the date of enactment of this Act, the Director of the National Science Founda-

tion shall enter into an arrangement with the National Research Council of the National Academy of Sciences to conduct a triennial evaluation of the Federal nanotechnology research and development program, including—

(i) a review of the technical success of the program in achieving the stated goals and grand challenges under the metrics established by the program and the nanotechnology Advisory Panel, and under other appropriate measurements;

(ii) a review of the program's management and coordination across agencies and disciplines;

(iii) a review of the funding levels by each agency for the program's activities and their ability with such funding to achieve the program's stated goals and grand challenges;

(iv) recommendations for new or revised program goals and grand challenges;

(v) recommendations for new research areas, partnerships, coordination and management mechanisms, or programs to be

established to achieve the program's stated goals and grand challenges;

(vi) recommendations for investment levels in light of goals by each participating agency in each program funding area for the 5-year period following the delivery of the report;

(vii) recommendations on policy, program, and budget changes with respect to nanotechnology research and development activities;

(viii) recommendations for improved metrics to evaluate the success of the program in accomplishing its stated goals; and

(ix) a review of the performance of the Information Services and Applications Council and its efforts to promote access to and early application of the technologies, innovations, and expertise derived from program activities to agency missions and systems across the Federal government and to United States industry.

(B) EVALUATION TO BE TRANSMITTED TO CONGRESS.—The Director of the National Science Foundation shall transmit the results of

any evaluation for which it made arrangements under subparagraph (A) to the Senate Committee on Commerce, Science, and Transportation and the House of Representatives Committee on Science upon receipt. The first such evaluation shall be transmitted no later than 12 months after the date of the enactment of this Act, with subsequent evaluations transmitted to the Committees every 3 years thereafter.

SEC. 6. AUTHORIZATION OF APPROPRIATIONS.

(a) NATIONAL SCIENCE FOUNDATION.—

(1) GENERAL AUTHORIZATION.—There are authorized to be appropriated to the Director of the National Science Foundation to carry out the Director's responsibilities under this Act—

(A) $221,000,000 for fiscal year 2003; and

(B) $254,150,000 for fiscal year 2004.

(2) SPECIFIC ALLOCATIONS.—

(A) INTERDISCIPLINARY NANOTECHNOLOGY RESEARCH CENTERS.—Of the amounts described in paragraph (1), $40,000,000 for fiscal year 2003, $50,000,000 for fiscal year 2004, shall be available for grants of up to $5,000,000 each for multidisciplinary nanotechnology research centers.

(B) CENTER FOR SOCIETAL, ETHICAL, EDUCATIONAL, LEGAL, AND WORKFORCE ISSUES RELATED TO NANOTECHNOLOGY.—Of the sums authorized for the National Science Foundation each fiscal year, $5,000,000 shall be used to establish a university-based Center for Societal, Ethical, Educational, Legal, and Workforce Issues Related to Nanotechnology.

(C) NATIONAL NANOTECHNOLOGY COORDINATION OFFICE.—Of the sums authorized for the National Science Foundation each fiscal year, $5,000,000 shall be used for the activities of the Nanotechnology Coordination Office.

(D) GAP FUNDING THROUGH THE SCIENCE AND TECHNOLOGY POLICY INSTITUTE.—Of the sums authorized for the National Science Foundation each fiscal year, $5 million shall be for the Science and Technology Policy Institute, in consultation with the Office of Science and Technology Policy, for use in competitive grants to address research areas identified by the council under section 5(a)(9) of this Act. Such grants may be made to government or non-government awardees.

(b) DEPARTMENT OF ENERGY.—There are authorized to be appropriated to the Secretary of Energy to carry out the Secretary's responsibilities under this Act—

(1) $139,300,000 for fiscal year 2003; and

(2) $160,195,000 for fiscal year 2004.

(c) NATIONAL AERONAUTICS AND SPACE ADMINISTRATION.—There are authorized to be appropriated to the Administrator of the National Aeronautics and Space Administration to carry out the Administrator's responsibilities under this Act—

(1) $22,000,000 for fiscal year 2003; and

(2) $25,300,000 for fiscal year 2004.

(d) NATIONAL INSTITUTES OF HEALTH.—There are authorized to be appropriated to the Director of the National Institutes to carry out the Director's responsibilities under this Act—

(1) $43,200,000 for fiscal year 2003; and

(2) $49,680,000 for fiscal year 2004.

(e) NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY.—There are authorized to be appropriated to the Director of the National Institute of Standards and Technology to carry out the Director's responsibilities under this Act—

(1) $44,000,000 for fiscal year 2003; and

(2) $50,600,000 for fiscal year 2004;

(f) ENVIRONMENTAL PROTECTION AGENCY.—There are authorized to be appropriated to the Administrator of the Environmental Protection Agency to carry out the Administrator's responsibilities under this Act—

(1) $5,000,000 for fiscal year 2003; and

(2) $5,750,000 for fiscal year 2004.

(g) DEPARTMENT OF JUSTICE.—There are authorized to be appropriated to the Director of the National Institute of Justice to carry out the Director's responsibilities under this Act—

(1) $1,400,000 for fiscal year 2003; and

(2) $1,610,000 for fiscal year 2004.

SEC. 7. ADDITIONAL REPORTS, STUDIES, AND PLANS.

(a) INTERNATIONAL BENCHMARKING STUDIES.—

(1) UNITED STATES STANDING TO BE MONITORED.—In order to maintain world leadership in nanotechnology, the program established under section 4(a) shall monitor the United States' standing in the key research fields that support technological innovation.

(2) BIENNIAL NSTC STUDY OF RELATIVE UNITED STATES POSITION.—Not later than 3 months after the date of enactment of this Act, the President, through the Council, shall enter into an arrangement with the National Research Council of

the National Academy of Sciences to conduct a biennial study of the relative position of United States compared to other nations with respect to nanotechnology research and development.

(3) ISSUES TO BE ADDRESSED.—The study required by paragraph (2) shall address, among other issues—

(A) the current and likely future relative position of United States private sector, academic, and government research in nanotechnology relative to other nations;

(B) niche nanotechnology research areas where the United States is trailing other nations;

(C) critical research areas where the United States should be the world leader to best achieve the goals of the Federal nanotechnology research and development program;

(D) key factors influencing relative United States performance in this field; and

(E) institutional, funding, and human-resource factors that are critical to maintaining leadership status in this field.

(4) ACTION PLAN.—Not less than 6 months after receipt of each study, the Council shall develop a plan for addressing the issues raised in the study. The plan shall include—

(A) investment strategies for addressing the issues raised in the report;

(B) strategies for promoting international research cooperation to leverage international niches of excellence identified by the report; and

(C) institutional and human-resource changes to be made to achieve or maintain leadership status in this field.

(5) TRANSMITTAL TO CONGRESS.—The Council shall submit the study required by paragraph (2) and the plan required by paragraph (4) to the Senate Committee on Commerce, Science, and Transportation and the House of Representatives Committee on Science, not later than 18 months after the date of enactment of this Act and every 2 years thereafter.

(b) SOCIETAL, ETHICAL, EDUCATION, LEGAL, AND WORKFORCE ISSUES RELATED TO NANOTECHNOLOGY.—

(1) STUDIES.—The Director of the National Science Foundation shall encourage, conduct, coordinate, commission, collect, and disseminate studies on

the societal, ethical, educational, and workforce implications of nanotechnology through the Center for Societal, Ethical, Educational, and Workforce Issues established under section 4(c)(5). The studies shall identify anticipated issues and problems, as well as provide recommendations for preventing or addressing such issues and problems.

(2) DATA COLLECTION.—The Director of the National Science Foundation shall collect data on the size of the anticipated nanotechnology workforce need by detailed occupation, industry, and firm characteristics, and assess the adequacy of the trained talent pool in the United States to fill such workforce needs.

(3) ANNUAL REPORT.—The Director of the National Science Foundation shall compile the studies required by paragraph (2) and, with the assistance of the Center for Ethical, Societal, Educational, Legal, and Workforce Issues Related to Nanotechnology established by paragraph 4(c)(5) if this Act, shall complete a report that includes a description of the Center's activities, which shall be submitted to the President, the Council, the Senate Committee on Commerce, Science, and Transportation, and the House of Representatives Committee

on Science not later than 18 months after the date of enactment of this Act.

SEC. 8. DEFINITIONS.

In this Act:

(1) ADVISORY PANEL.—The term ''Advisory Panel'' means the President's National Nanotechnology Panel.

(2) FUNDAMENTAL RESEARCH.—The term ''fundamental research'' means research that builds a fundamental understanding and leads to discoveries of the phenomena, processes, and tools necessary to control and manipulate matter at the nanoscale.

(3) GRAND CHALLENGE.—The term ''grand challenge'' means a fundamental problem in science or engineering, with broad economic and scientific impact, whose solution will require the application of nanotechnology.

(4) INTERDISCIPLINARY NANOTECHNOLOGY RESEARCH CENTER.—The term ''interdisciplinary nanotechnology research center'' means a group of 6 or more researchers collaborating across scientific and engineering disciplines on large-scale long-term research projects that will significantly advance the science supporting the development of

nanotechnology or the use of nanotechnology in addressing scientific issues of national importance, consistent with the goals set forth in section 4(b).

(5) NANOTECHNOLOGY.—The term ''nanotechnology'' means the ability to work at the molecular level, atom-by-atom, to create large structures with fundamentally new molecular organization.

(6) PROGRAM.—The term ''program'' means the national nanotechnology research program established under section 4.

(7) RESEARCH INFRASTRUCTURE.—The term ''research infrastructure'' means the measurement science, instrumentation, modeling and simulation, and user facilities needed to develop a flexible and enabling infrastructure so that United States industry can rapidly commercialize new discoveries in nanotechnology.

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